

CLAIMS

1. A method for characterizing an elasticity property of a viscous medium, the method comprising:
 - (a) directing an ultrasound wave in the viscous medium to produce a vibrational force on the medium at a focal point of the transducer;
 - (b) determining a vibrational velocity of the medium as a function of the frequency of vibration;
 - (c) repeating steps (a) and (b) for a plurality of frequencies to develop a resonance spectrum of the medium;
 - (d) determining a resonant frequency of the viscous medium; and
 - (e) determining the elasticity property as a function of the resonant frequency.
2. The method as defined in claim 1, wherein the ultrasound wave is an amplitude modulated wave.
3. The method as defined in claim 1, wherein the ultrasound wave is a confocal ultrasound wave.
4. The method as defined in claim 1, wherein the ultrasound wave comprises ultrasound waves produced by a plurality of ultrasound sources.
5. The method as defined in claim 1, wherein step (e) comprises comparing the resonant frequency to known values of resonant frequencies.

6. The method as defined in claim 1, wherein step (b) comprises sensing the vibrational motion of the medium with a laser vibrometer.
7. The method as defined in claim 1, wherein step (b) comprises sensing the vibrational motion of the medium with an ultrasound based motion detector.
8. The method as defined in claim 1, wherein the elasticity property comprises at least one of a shear modulus or a shear viscosity of the medium
9. The method as defined in claim 1, wherein the viscous medium is a biological tissue.
10. A method for characterizing tissue, the method comprising the following steps:
 - (a) directing a ultrasound wave operating at a first oscillating frequency at a focal point in the tissue;
 - (b) measuring a vibrational velocity of the tissue at the focal point;
 - (c) varying the oscillating frequency over a range selected to produce a resonant frequency response in the tissue;
 - (d) correlating the resonant frequency to a known elasticity parameter associated with the resonant frequency.
11. The method as defined in claim 10, further comprising the step of varying the focal point across a selected portion of tissue to characterize changes in the tissue.
12. The method as defined in claim 11, further comprising the step of differentiating a first type of tissue from a second type of tissue.

13. The method as defined in claim 12, wherein one of the first and second types of tissue is a calcification.

14. The method as defined in claim 10, further comprising the step of characterizing tissue as a function of time.

15. An apparatus for determining a elasticity property of a viscous medium, the apparatus comprising:

(a) an ultrasound transducer for applying an ultrasound beam operating at a selectively varying frequency at the viscous medium;

(b) a detector for measuring a velocity and a frequency of vibration of the medium; and

(c) a processing unit, the processing unit electrically connected to:

- (i) drive the ultrasound transducer at varying frequencies over a selected frequency range;
- (ii) receive the velocity and frequency of vibration from the detector; and
- (iii) determine a resonant frequency at selected positions within the medium;

and

(iv) determine at least one of a shear elasticity and a shear viscosity as a function of the resonant frequency.

16. The apparatus as defined in claim 15, further comprising a memory component connected to the processor for storing a resonance spectrum profile correlating the vibrational velocity of the medium versus the frequency of vibration of the medium.

17. The apparatus as defined in claim 16, wherein the memory component further comprises a data structure storing known resonant frequencies and correlating the known resonant frequencies to at least one of a shear modulus and a shear viscosity.
18. The apparatus as defined in claim 15, wherein the transducer produces an amplitude modulated signal.
19. The apparatus as defined in claim 15, wherein the transducer is a confocal transducer.
20. The apparatus as defined in claim 15, wherein the detector is a magnetic resonance elastography system.
21. The apparatus as defined in claim 15, wherein the detector is an ultrasound based motion detector system.